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ABSTRACT

This literature review selectively covers material on end-user searching published between 1971 and 1988. The first section discusses end-user search systems--e.g., multipurpose systems developed for end-users, simplified versions of traditional systems, gateway systems, and CD-ROM versions of databases. This section also discusses the complexity of offline search software. Research on end-user searching by various groups or in special settings are addressed in the second section, e.g., scientists, physicians, academics, schools, lawyers, journalists, brokers, and libraries. The next two sections consider end-user training and performance. A discussion of future developments in end-user searching concludes the review. The 155 references listed are organized by broad topics corresponding to sections of the review. (MES)

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END-USER SEARCHING: A Selection of the Literature for 1983-1988

by

Geraldene Walker

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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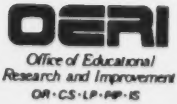

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Introduction

It has been suggested that the original designers of online bibliographic search systems had expected that their users would be the actual information-seekers themselves (Walker, 1971), but it soon became apparent that these early systems were too complex for efficient use by occasional users, and over the years the role of the librarian as the search intermediary developed. Though some early efforts were made to encourage specialized groups of end-users to search for themselves, system usage was generally disappointing. It appeared that most users were not prepared to make the necessary investment of time and effort required to become proficient searchers, and those who continued to use a system usually performed only simple searches. Until the early 1980s the professional searchers provided a closeknit and well-defined, if limited, market for the online systems vendors. There seemed to be general agreement that online searching required the expertise of a highly trained professional. The microcomputer revolution was to be the catalyst from which the myth of unlimited markets for online searching emerged.

Over the last four or five years the term "end-user" has become common-place, and research reports and journal articles on the direct use of online systems by those seeking information have been appearing at such a rate that keeping up with the literature has become almost impossible. A number of monographs have also been published recently (Batt, 1988; Kesselman & Walstein, 1988; Nicholas, Harris & Erbach, 1987; Wood, Horak & Snow, 1986). A number of previous bibliographies (Lathrop, 1987; Lyon, 1984; Wood, 1986) and reviews (Bellardo, 1981; Eisenberg, 1983; Lowry, 1982) have covered the early literature and provide a background against which more recent developments are discussed here. This review does not attempt to cover every item relevant to the field (there are too many), but organizes material around a list of topics that have developed as areas of major interest—systems, environments, training, performance, and the evolving role of the librarian in the provision of online information.

The earliest studies of end-user searchers were of specialized user groups. For example, investigations of scientists and engineers using the NASA database (Summit, 1968), or health

care practitioners using the National Library of Medicine EL-HILL system (Lancaster, 1972), or the Mead Data Central free-text system (Lancaster, Rapport & Penry, 1972), all suggested that well-educated personnel were capable of performing productive searches with only minimal training. Although most of these early users were regular and experienced computer users, research showed that relatively small numbers of them were interested in using the systems, and that their perceptions of them in terms of syntax, database structure, and content were frequently inaccurate. Their attitudes were found to vary with a range of features, such as experience, subject field, age, and cognitive skills (Borgman, 1984), but most of them found on-line searching to be too difficult. How, then, can the ordinary information-seeker be expected to deal with the complexities of these online search systems?

End-user Search Systems

The wide availability of microcomputers that can function as dial-up terminals, together with a general increase in levels of computer literacy, have helped to create a new environment for online searching, and the suggestion that end-users of all types could and should perform their own searches has resurfaced. By 1983 it had become clear that the available systems were too difficult for occasional users, and moves to simplify system access have opened up a range of new search options. This broader potential market has encouraged the development of simplified systems aimed specifically at the end-user market, as well as software packages that simplify the user interface.

These developments have led to a growing interest within the information profession in the potential of end-user searching. The educational and professional backgrounds of end-users, methods for training them, and the levels of motivation and satisfaction they achieve have all been discussed in a subjective fashion. Articles offering advice on the implementation of such services in libraries are appearing more and more frequently (Broering, 1985; Casbon, 1983; Des Chene, 1985; Halperin & Pagell, 1985; Hunter, 1983, 1984), and popular microcomputer magazines now carry articles selling (or even over-selling) the advantages and simplicity of online search services for personal research (Diodato, 1984; Glossbrenner, 1983; Hecht, 1985; Pearlman, 1984; Tenopir, 1984; Tousignant, 1983; Zarley, 1983).

Two computer-assisted approaches to searching are currently available—the new online search services aimed specifically at the end-user market, and database access software, also called "gateway" software or "computer intermediaries." Despite the diversity of products and services that have appeared in the marketplace, most fall into one of these two basic groups.

End-user Systems:

- Multi-purpose systems developed directly for end-users, such as The Source or Compuserve, which provide electronic mail, bulletin boards, and online shopping, as well as bibliographic information;
- Simplified versions of the traditional systems, such as BRS/After Dark, BRS/Colleague, and Knowledge Index,

which provide access to sub-sets of the full systems via a menu-driven front-end interface and using the same command language and Boolean logic as the full system;

- Gateway systems which simplify access to a number of different search services via a single password and a common command language, i.e., systems such as EASYNET or iNet. They obviate the need to learn more than one search language and assist with the selection of an appropriate database, regardless of system; and
- CD-ROM versions of many of the same databases that are available online, which use a variety of different search languages, but make it possible to search without the constraints of connect time.

Search Software:

- Software packages such as Prosearch and SearchHelper, which permit the search to be entered offline and results to be downloaded. These packages interpose a simplified protocol based on selection menus at the user end of the online interaction, and may cover a range of different systems, or be limited to a single system or group of databases.

The impetus towards the design and development of these more transparent systems is based on the assumption that there is a vast potential market which is currently discouraged by the complexity of the available systems. Tenopir (1985) has suggested that even these newer systems need improving, that the market is not yet ready, and that most of the people in this potential market do not yet realize that access to databases can provide information that they need.

The market is potentially very diverse, though Ojala (1986) identified it as being limited to "professional/technical/managerial people and students." She suggested that such users are "reasonably affluent, relatively young and computer literate," though she offered no evidence to support such opinions. In fact, current users seem to "exhibit a great diversity in background, goals, needs, capabilities and personality" (Olmsted, 1986), and many of them may not be library users or have ever seen an online search performed. They appear to become end-users for a variety of reasons—to increase their job skills, to meet academic requirements, to solve job-related problems, or merely to try something new. Generally they have two characteristics in common—they are all interested in learn-

ing to search and they are also experienced computer users. It is believed that the numbers of these searchers can be expected to increase considerably as personal computers become more widely available and as more scientists are exposed to online searching in their formative years. Nevertheless, one can only agree that:

> It would be deplorable if the move to end-user searching should lead to a reduction not only in the range of information sources employed, but also in the effectiveness of their use. (Hunter, 1983, p. 229)

A useful overview of end-user bibliographic search systems is provided by Shedlock (1986), who listed BRS/After Dark, BRS/Colleague, Knowledge Index (DIALOG), PaperChase (Beth Israel Hospital, Boston), PDQ (National Cancer Institute), AMA/Net (American Medical Association), and MEDIS (Mead Data) as end-user systems available at that time. Since the market is continually changing and diversifying, published information quickly becomes out-of-date, and vendor promotional material is frequently unrealistic. Almost every one of these products and systems has received reviews too numerous to list here, particularly since much of the information contained in them is now out of date. Comparisons of two or more gateway or front-end systems are perhaps more helpful for the identification of features likely to be of use (Rudin, Hausele, Stollack & Sonk, 1985). Library requirements can be summarized as support for multiple communication protocols and autodial functions, reasonable prices, and an accounting and reporting structure to assist management decision-making (Santosuosso, 1986). Other writers offer advice on the selection of hardware and software to address these functions (Hunter, 1984). A range of features that would be attractive to users, on the other hand, might include immediate onsite access, the automation of connect protocols, and some sort of cost control (Williams, 1985). Two major features are suggested by King and Brueggeman (1986) to assist with search formulation:

- Pre- and post-processing, meaning the facility to upload a search and to download the results for editing and reformatting offline, and
- Assistance with database selection, an area which was previously identified as a problem by Walker & Eisenberg (1985).

Both of these features are usually available via the menus available on most search systems and on software packages designed for end-users, but reports on their use suggest that they do not provide sufficient help, and that there are other types of assistance needed by naive searchers to make the most efficient use of Boolean-type search systems.

End-user Environments

As indicated earlier, most early reports of end-user searching relate to the direct use of the older traditional systems by specialist groups. They are grouped here by their search environments.

Scientists

There have been a number of studies reported from industrial, scientific, and technical settings, but findings have varied. Levels of usage are generally reported to be low (20% by Richardson, 1981), and he suggests that the mere availability of a new search tool does not necessarily change the entrenched information-gathering habits of users. In contrast, some other studies have found that users of very specific and highly-organized databases often do prefer to do their own searching. Haines (1982) reported that almost half of the users who were initially trained at the Kodak Research Laboratories in Rochester were still searching at the end of a year, and over 75% were fairly well satisfied with their results. A follow-up study by Haines, Najjar, and Wehner (1986) suggested that the convenient siting of equipment and brief ongoing training sessions were the major factors that encouraged continued use and improved performance. Several writers have commented on the difficulty of the search process for casual and infrequent users (e.g., Walton & Dedert, 1983), and pointed out that high initial enthusiasm has a tendency to evaporate in the face of the time and effort necessary to master and retain search skills.

Similar initial enthusiasm was reported from the trial use of EasyNet at AT&T Bell Laboratories (Hawkins & Levy, 1986). Although these end-users were a group of regular computer users, frequent problems were reported, and it was considered that the user interface needed considerable improvement. Nevertheless, the trial confirmed that sufficient interest in direct searching did exist to make the provision of such a service worthwhile. These research scientists were particularly enthusiastic about the convenience of access from terminals in their own offices.

Experiences with end-user searching started early (1975) at American Critical Care, a pharmaceutical division of the American Hospital Supply Corporation, but original numbers

there have also dwindled (Leipzig, Kozak & Schwartz, 1983). Many of their users still prefer to delegate complicated and comprehensive searches to the information professionals. A summary of their search behavior notes that they preferred "to 'think' online, resist the use of a thesaurus, dislike typing, have trouble remembering commands, and prefer to delegate complicated and comprehensive searches to information professionals" (p. 325). These authors believe that online search systems will not become more widely used in organizations such as theirs until the physical search becomes easier, there is more access to actual facts (full-text and data files), and until microcomputers are more commonplace in the work environment.

Physicians

Similar results have also been reported from an investigation of a small sample of hospital physicians (Poisson, 1986). Although more than 70% of them claimed to be interested in searching, only 7% eventually became frequent searchers. A longer term investigation of medical end-users provides a very similar summary of their search behavior: End-user searchers spend more time online than a trained professional, resist use of a thesaurus, generally dislike typing, have trouble remembering commands, and prefer to delegate complicated and comprehensive searches to a professional searcher. Use is remarkably low and has dropped over the years, despite initial training and enthusiasm (Leipzig et al., 1983, p. 30).

This low usage among physicians confirms earlier research on the use of MEDLINE and TOXLINE by Sewell and Bevan (1976), who found that infrequent users had many mechanical problems, frequently misunderstood system responses, and often omitted necessary terms from their search strategies. Most users made little use of Boolean logic, and though connect time per search varied widely, it tended to increase rather than decrease with experience. A recent report on the continuation of this study (Sewell & Teitelbaum, 1986) identified convenience, accessibility, and speed as more important for this group of specialist users than either the cost or the quality of their results. A number of other writers discuss end-user searching on various of the medical databases (Horowitz & Bleich, 1981; Horowitz, Jackson & Bleich, 1983a, 1983b; Marshall, Banner & Chouinard, 1986; Marshall, 1987) and reach very similar conclusions.

Academics

The proportions of information-seekers who are interested in the direct use of online systems also appear to be very similar in other information environments. For example, in an academic setting, although nearly 50% of one group of potential users volunteered for training, 45% never used the system (Davidson & Hurd, 1985), and the 13% who became regular users were mainly graduate students. Only one faculty member, who had online access from his own office, became a regular searcher, confirming the prime importance of accessibility and convenience as criteria to encourage use by busy professional information-seekers.

Early reports of the academic use of the "user-friendly" systems are descriptive and subjective, concentrating on the mechanics of organizing such a search service, the attitudes of the end-user searchers, and the demographics of the user group. More recent studies have provided some details of how the newer systems, particularly BRS/After Dark, are used by end-users in library settings.

For example, self-searching was an option offered to users at the University of Ottawa in 1983, with the selection of searchers being based on the suitability of the user's request, i.e., databases available on BRS/After Dark, the number of references required, and the required turnaround time. In response to a questionnaire, users reported that they found the menu-driven protocols and commands easy to use, and felt "comfortable" with the hardware, despite minimal familiarity with computers or telecommunications (Janke, 1983). In fact, 72% of these users claimed that they would be willing to run all of their own searches online in the future, so long as technical help would be available if required, i.e., in cases of hardware or software malfunction. During the following year 227 online searches out of 1,537 at the University of Ottawa were performed by end-users. They were characterized by the use of basic commands and simple Boolean operations, but were reasonably effective despite their lack of sophistication. They also cost only one-half to one-third of the price of searches performed by intermediaries (Janke, 1984), a finding in contrast with most other studies, where end-user searching tends to cost more in terms of connect-time.

A similar study at the University of Wisconsin-Stout reported on 20 searches performed by students and faculty on the BRS/After Dark system (Trzebiatowski, 1984). Users were

given a pre-search orientation session covering both the system and the hardware. Sixty percent found their search to be easier than expected and 85% considered their results to be "good" or "excellent." They considered strategy formulation the most difficult aspect of searching, though their confidence in their search effectiveness may have been misplaced, since some commands (e.g., truncation) were unknowingly misused. Novice searchers were found to be much slower than intermediaries (26.98 minutes as compared with 7.1 minutes of connect time), though overall computer costs did not differ greatly because much of the users' connect time was "thinking" time rather than CPU time. Users appeared to need considerable instruction in certain basic aspects of searching, such as choosing the most appropriate database, the selection of alternative search terms, and the construction of a search strategy.

Both of these studies appear to confirm the potential for direct end-user searching using simplified online bibliographic systems such as BRS/After Dark, though they also emphasize the necessity of retaining professional searchers, as well as the need for considerable training and backup.

Faculty in science and education were the major online users in another study and also the largest group of self-searchers (Torok & Hurych, 1986). Another report of faculty searching at the University of California, Riverside, on a single database (Bodtke-Roberts, 1983), confirms that use dropped significantly after the initial four months. The most influential factor in determining continued use appeared to be "the existing patterns of organizing work in their labs." Another study of scientists using the CAS-Online Academic Plan at Northwestern University (Davidson & Hurd, 1985) suggested that the type of searches performed, as well as usage, depended heavily on the methods used for academic subject teaching. It was concluded that training should be aimed at specific sub-disciplines of chemistry, rather than giving all chemists the same general introduction.

A study by Norton and Westwater (1986) of final year business students using the Data-Star system suggests that six to eight sessions are required for users to become capable of searching on their own. Users are like most other computer users in that they do not want to read manuals, and they like to read their results live on the screen—an expensive mode of operation. These researchers emphasize the need for technological backup, and conclude that an expert system interface

may well be required to assist end-user access to more than a single host, where the difficulties are increased by varying command languages and protocols. Two reports of searching by graduate students in business confirm that users are happy with their results (Garman & Pask, 1985) and would be willing to pay up to $5.00 for their online information (Halperin & Pagell, 1985).

It is surmised that simple searches available immediately are probably what most such users require (Littlejohn, 1987), and few of them take the initiative to ask for vendor manuals or prepare their searches in advance. Nevertheless, they were not averse to receiving suggestions from library staff while they were actually searching, which confirms the need for assistance beyond the mere mechanics of operation. Although almost all of these writers report highly enthusiastic reception of end-user search services and high levels of subjective satisfaction, it does seem that most university students and faculty have remained largely unaware of and uninterested in the research potential of online bibliographic databases.

Schools

Perhaps this lack of awareness and interest on the part of university students will change in the near future, as online access has more recently become available in a variety of school settings and many high school students are being exposed to computer searching.

The Department of Education in Virginia has recently recommended that knowledge and understanding of electronic databases and online searching should become a part of a new basic competency requirement for all graduating high school seniors. Such searching is viewed as a means for the reinforcement of research and library skills for all information-seeking in the future (Caputo, 1985), and a number of individual high schools, junior high schools, and even elementary schools are now experimenting with allowing students to search using the DIALOG Classmate (Lodish, 1987; Pruitt & Dowling, 1985; Wozny, 1982), BRS/Instructor (Epler, 1987), Wilsonline (Callison & Daniels, 1986, 1988), or Dow Jones News/Retrieval (Lynch, 1987) services.

It is notable that almost all of this searching in schools is being done on the full versions of the online systems, since few schools appear to be making use of the "user-friendly" versions, possibly because of the limited access times. This

approach is based on the belief that planting the seed early will have long-term effects on the way students perceive information services at colleges and universities, and the way in which they conceptualize the search process (Aversa & Mancall, 1987).

Lawyers

Two reports of searching by legal professionals also emphasize the importance of convenience and accessibility for another group of naive users (Hawkins & Levy, 1986; Vollaro & Hawkins, 1986). It was discovered by chance that there was a movement towards end-user searching among a group of patent attorneys at AT&T Bell Laboratories, who had obtained their own DIALOG passwords and were doing their own searching, despite the availability of an information retrieval service staffed by subject specialists. An analysis of these end-users showed that they used only a limited number of databases and took longer than intermediaries per search, that their initial enthusiasm tended to fall off to about 55% over time, and that they cited convenience (terminal in the office) and flexibility (no time restrictions) as the major reasons why they had originally been attracted to self searching. Since comprehensiveness is particularly critical to patent searching, the limited number of databases used was a matter for concern among the professional search analysts within the organization. Once again it was surmised that it was the immediate feedback that was the attraction for this group of users. A small study of student use of Lexis and Westlaw at Albany Law School Library (Ma, 1987) shows similar high levels of use, particularly by the more advanced students. Reasons for this were believed to be the large numbers and convenient siting of access terminals, vendor training of all students, and the incorporation of online research skills into the school curriculum. It is suggested that since lawyers are a professional group who, like physicians, are well-served by a limited number of very specific databases, they may consequently be more likely to adopt online searching as part of their everyday information-seeking behavior.

Journalists

An attempt to assess the likely market for online information among a group of British journalists, a professional group for whom currency might be expected to be especially important, reported very low levels of user acceptance (Nicholas, Harris,

& Erbach, 1986, 1987a, 1987b). Although news organizations are invariably well-staffed with experienced information handlers who are interested in the potential of online systems, it appeared here that most of them were not inclined to switch from their familiar information-gathering habits. The authors comment that although the role of "noise" in information use by journalists would seem to make them "ideal as end-users specializing in the 'quick and dirty' search" (p. 113), only a few "early leaders" emerged, who frequently acted as "gatekeepers" for their colleagues.

A similar lack of interest was exhibited by a group of journalists at Reuters, where press cuttings files were being replaced by the Newsbank full-text database (Harman, 1986). All users felt that this system was particularly difficult and clumsy to use, that the documentation was poor, and that some training was essential. A number saw the concept of direct use as "a waste of time," taking the journalist away from his main professional tasks of writing and editing. They believed that information retrieval was not part of their job, but should be carried out by trained librarians.

Nicholas, Harris, and Erbach (1987b) found that Textline was the only exception to these findings, possibly because it was well marketed, had appropriate coverage, was up-to-date, was very user-friendly, and also provided additional information via abstracts. They concluded that job perceptions, job pressures, and personal attitudes towards information technology in general, were all reasons that had prevented the faster spread of end-user searching among this population of journalists.

Experiences at Canada's *Globe and Mail* newspaper provide a very different picture. Their primary database is the full-text version of the newspaper itself back to 1977. Its user-base has grown from 200 to 3,500 in 10 years, and includes not only the entire editorial staff of the newspaper, but also many outside customers, including managers, accountants, lawyers, sales staff, and other researchers (Marble, 1985). The innovative approach to assisting these untrained searchers has been through the development of a limited number of sub-databases, which contain stored search strategies for common topics (known to professionals as "hedges"). Although these can by no means be considered sophisticated search strategies, they do enable completely naive searchers to make use of the system.

Brokers

Despite their familiarity with the handling of electronic information and the availability of a wide variety of economic, financial, and news databases in their field, an even clearer lack of interest was exhibited among stockmarket traders (Nicholas, Harris & Erbach, 1987a). Their problem appeared to be information overload—the normal trader is so totally preoccupied with the interpretation of the ever-changing raw data online, that he has no attention to divert to collecting background information. It is suggested that this may be a field in which access may well revert to the ultimate information-seeker—the investor operating on his own personal computer and bypassing the trader altogether. The authors conclude that, despite "the fact that most of these people are heavily engaged in the retrieval, packaging, processing or dissemination of information seems not to matter greatly. . . . The take-up of online. . . has been patchy to say the least" (p. 147).

Libraries

In view of this low level of interest from end-users in a wide range of environments, one must have reservations about the extent of such searching for the foreseeable future. It appears that many libraries are also using these simplified systems as a cheaper alternative to the daytime systems for intermediary as well as end-user searching (Gordon, 1985), while others are using the newer systems to cover hours when staff are not available for regular searching. Some libraries are charging special low rates, for example $5.00 per half hour, and leaving users to manage as best they can. Despite the fact that there are obviously conceptual misunderstandings, high levels of satisfaction are reported (Slingluff, Lev & Eisan, 1985). Indeed, one library offering end-user searching free of charge has found it almost impossible to meet demand, and emphasizes the need for substantial staff commitment for the training of and assistance to the users (Jaros, Anders & Hutchins, 1986).

It would appear that, although numbers of end-user searchers were initially small in almost all search environments and have not expanded as swiftly as had been expected, the potential of a mass market is still there. Many libraries are persevering with the move to direct end-user access, particularly in light of current financial constraints and the availability of CD-ROM databases.

End-user Training

Almost all writers mention the need for library support for an end-user search service, since most users will be searching relatively infrequently, and will not expect it to require undue effort. Much discussion has centered around the most effective methods for training end-users. Most success in terms of continued searching seems to be linked to the use of a single database or to the integration of online searching into general academic course-based bibliographic instruction programs (Ward, 1985; Ward & Osegueda, 1984). Some writers mention the need for better system help, particularly with database and search term selection or with the use of Boolean logic (Slingluff et al., 1985), and it seems clear that the present front-end systems do have some serious limitations for untrained users.

Norton and Westwater (1986) found that the quality of the searches does not appear to be affected by either the "friendliness" of the system (BRS/Colleague as compared with MEDLINE), the frequency of searching, or the length of time a user had been searching. They identified "method of training" as the key variable to affect search performance. Users with the best results had been taught by a librarian, as opposed to teaching themselves from system documentation or by using a computer-aided instruction program (MEDLEARN), or even receiving instruction at a system training session. These results confirm earlier findings by Olson (1975), who had also concluded that users taught by librarians were better able to use the interactive capabilities of the system and understand the controlled vocabulary.

Many professional intermediaries now appear to have accepted the change in their role as information providers, and have become involved in the design and implementation of end-user training. The Houston Academy of Medicine-Texas Medical Center has one of the most extensive user education programs, and their philosophy toward the role of the librarian is that "all librarians can, should, and must teach" (Hubbard & Wilson, 1986). With tremendous support and financial backing, a large "instructor pool" draws on the expertise of individual librarians in the preparation and presentation of various seminars on information management. A community material and

teaching file is maintained to minimize duplication of preparation and the spread of teaching load. They consider that this program has had a profound effect on the expectations and perspectives of their clientele.

The common factors among other training courses appear to be the combination of materials presented in lectures, often targeted to particular user groups (Ostrum & Yoder, 1985), with class handouts, slides/overheads, graphics (Batista & Einhon, 1987), and with demonstrations and practice sessions. A number of writers recommend a modular approach (Pritcher, 1985; Vigil, 1984) to separate the mechanics of online from the more conceptual aspects of search strategy development and database structure and content. It seems that some intermediaries still prefer to leave this training to the vendors, particularly for the more complicated files (Bodtke-Roberts, 1985; Ma, 1987). On the other hand, there are also reports of end-users teaching one another and sharing personally-developed search aids (Marin & Dutton, 1985). The length of training offered has varied widely, from none at all (Crooks, 1985), to (most commonly) a single session of one or two hours (Brandon & Wehmeyer, 1985; Davidson & Hurd, 1985; Givens & McDonnell, 1985; Ostrum & Yoder, 1985; Haines, Najjar, & Wehner, 1986) to a series of continuing lectures over days or even weeks (Lucia & Royston, 1984; Walton & Dedert, 1983).

It is assumed that academic end-users are particularly likely to benefit from written materials to review after the workshop (Friend, 1986; Steffan, 1986), and end-users of all types appear to benefit from at least some documentation. But publications intended for professional searchers do not meet their needs (Snow, 1986). They need task- or goal-oriented materials that present information in the form of case studies or research problems (Shelton & Scharf, 1985). Formal reference manuals should be replaced by flash cards, pocket guides, and online tutorials. Janke (1985) predicts that ongoing presearch counselling will have to be combined with initial training, and Friend (1986) also emphasizes the role of the intermediary as counsellor to end-users.

An obvious development in instruction has been the idea of using the computer itself as a trainer, particularly since computer-aided instruction (CAI) has been widely used in other areas. The advantage of such an approach lies in the personal nature of the interaction, so that users may learn at their own pace and at the time most convenient to their schedules. "CAI

drastically reduces the time necessary for training. . . [and] provides far more patience, consistency and individualized attention than any human teacher" (Franklin, 1985, p. 144). This type of "interactive courseware" can thus save both time and money, and more of these training aids are becoming available. Few generalized CAI software packages are available (Grotophorst, 1984), since most concentrate on a single system (Hutchins, Anders, & Jaros 1987; Ifshin & Hull, 1985; Large & Armstrong, 1983), or even a single database (Klausmeier, 1985).

Simulations are another computer method of training, which has the advantage of eliminating connect-time charges, and they have been in use for the training of intermediaries for a number of years (for example, packages such as Trainer, Diatom, and Dialtwig). Reports of their use with naive searchers are few, and are not enthusiastic (Marin & Dutton, 1985). It has also been found that bulletin board systems (which are available free) can be useful for the introduction of the idea of online systems and the mechanics of using telecommunications networks with the minimum of anxiety. "They offer an entertaining introduction to telecommunications, and provide opportunities for becoming proficient in using communications software" (Dowling & Pruitt, 1987). It seems likely that CD-ROM will be used as a similar training aid in the future. However, it is clear that:

> Training alone does not ensure use; according to Mooer's Law: an information retrieval system will tend not to be used whenever it is more painful and troublesome for a customer to have information, than for him not to have it. (Witiak, 1985, p. 54)

End-user Performance

Relatively little is known regarding the performance of end-users on the simplified online search systems, and the information that is available is largely descriptive and subjective. It is clear that "one can indeed sometimes easily and rapidly find a little material and mistakenly think that is all there is, when in fact other approaches can locate a great deal more" (Hunter, 1983, p. 228).

One recent study of end-users, which reports on the use of a gateway system (iNet) by 24 practicing physicians (Marshall, 1987; Marshall, Bonner, & Chousinard, 1986), found current online systems too expensive (an average of $85 per month) and too time-consuming (an average of 22.4 minutes per search) to be used extensively by untrained searchers. Although the majority of the searchers were already computer enthusiasts, they found the system less valuable and more difficult than they had expected, and the menu-driven systems were not considered to be markedly easier to use than the command-driven ones. In fact, once they had learned the command language, users realized that the original systems were faster and more direct.

There are a number of other recent studies which use such a comparative methodology. For instance, when searches performed by end-users on a "friendly" system (BRS/Colleague) were compared with searches for the same query performed by trained intermediaries on the full system (MEDLINE), 40% were considered to be equally successful (Kirby & Miller, 1985). Two-thirds of the other 60% were searches in which the end-user initially believed that he had found what he wanted until he saw the results obtained by the intermediary. Given this comparative insight, only 13% of the end-users finally felt that they would always like to perform their own searches in the future.

Another comparison reported was between online (BRS/After Dark) and manual searches performed by end-users for the same query (Penhale & Taylor, 1986). These users did not see online as a replacement for manual searching, though they retrieved as much in 20 minutes online as they did with two hours of manual searching. This study also compared user online searches with those of librarian searchers. Given the

same amount of time, the librarians retrieved more than twice as many citations as the end-users, and also five times as many of the most highly relevant items. Differences in precision, on the other hand, were not significant. Intermediaries made use of more synonymous search terms and also used more system commands than the end-user searchers in this study. They also made more use of the interactive capabilities of the system, using print commands to browse sets and find additional search terms to adapt their search strategies.

These results were recently confirmed by Walker (1988), who also compared end-user and intermediary results for the same query. An analysis of search failures suggested that the selection of effective search vocabulary was the major area of difficulty for naive users. Although the end-users performed extremely well in terms of the traditional measures of recall (54.4%) and precision (64.6%), their search times were almost twice as long as those of the intermediary searchers and their time (cost) per relevant citation retrieved was therefore doubled. The users also behaved very differently, using many more search terms, but fewer databases, system commands, and logical operators. They made many errors, were very inefficient, and often "abandoned" potentially useful sets without inspection, presumably because they were too large. Even so, users claimed that searching was "easy," that they were satisfied with their results, and that they had "enjoyed" the experience and intended to use online systems for all their information-seeking in the future.

Future Developments

The recent development of new search systems and interface software should have provided a solution to all these problems of complexity, but initial reports suggest that this is not so. Users of the simplified systems tend to have problems and behave in very similar fashions to those using the original systems. Online providers have found that "end-users are not able to use the machines easily and effectively" and that "supporting a product or service to an end-user requires a different set of skills" (Arnold 1986, p. 5). The market is currently very fragmented, with a range of differing user requirements. The vendor response to this situation has been the introduction of a range of new services aimed at particular segments of the market, such as medicine and business, where there are more homogeneous user groups.

Overall, the literature tends to suggest that these new groups of users are not as different from the earlier scientist-searchers as one might have expected. It appears that their searches are usually relatively simple (non-comprehensive/low recall) and make little use of the interactive capabilities of the online system. But they do achieve reasonable results, given sufficient time, and seem to enjoy the independence of self-searching. Nevertheless, they remain a small proportion of overall information-seekers.

How can the systems be made more accessible and end-user search performance be improved? It has been suggested that current measures of performance are little affected by variables which can be controlled, such as systems features and training (Fenichel, 1981; Hansen, 1986; Oldroyd, 1984), and more dependent on uncontrollable variables, such as searcher characteristics (Borgman, 1986), which makes the question of improving performance particularly difficult. There have been slight indications that younger people, people with a scientific background or computer experience, those who have seen an online search performed before, and those who have received particular types of online training may be more motivated to learn to search and to continue searching. Both intelligence (Bellardo, 1984) and personality (Teitelbaum-Kronish, 1984) have been excluded as predictors of search success, and although it is known that cognitive style does affect search

behavior, its effect on performance has not been demonstrated (Fidel, 1982; Rholes & Dressler, 1984; Woelfl, 1984).

The introduction of end-user searching in libraries has raised the question of the resulting position of the professional online searcher (Girard & Moreau, 1981; Lewis, 1980; Nielsen, 1980, 1982; Suprenant & Perry-Holmes, 1985). Janke (1984) has suggested that the need for librarian search analysts will remain for some years in order to perform searches that require involved search strategies or multi-database access, but that in the long term all end-users will perform their own searches using personal microcomputers, probably in their own offices. Other writers have insisted that it requires a trained professional to perform cost-effective searches (e.g., Peart, 1985), and Ojala (1985) emphasizes the need for cooperation between the information professional and the user population in order to ensure a good working relationship of benefit to both. The possibility of the expansion of centralized searching services has also been suggested (Faibisoff & Hurych, 1981), in which the library search analyst would be an important component.

A number of writers have listed occasions when end-user searching is most appropriate—e.g., for immediate information, when using a single database, or when only a few articles are required (Ojala, 1985, p. 96). It seems fair to conclude that end-user searching is not to every taste, and that it is not difficult to make a case for the continuation of the librarian as intermediary. Supporting end-user searching with innovative programs and policies can very well enhance the status of librarians, providing new opportunities for growth and expansion as the library becomes the focus for information access. A greater respect and appreciation evolves as patrons better understand the complexities of effective and efficient searching. The recognition of libraries as not only the prime users of online services, but also as the source of technological know-how and search expertise, will be increasingly important in the future allocation of resources, personnel, and finances (Peischl & Montgomery, 1986).

Despite the continuing spread of online library catalogs and the enthusiastic reception of CD-ROM search facilities, many librarians remain unconvinced of the effectiveness of end-user searching. Nevertheless, most writers appear to accept that the role of the intermediary has changed from the provider of a

single mediated search service to the manager of a variety of search options—service or self-service, external or in-house databases, free or cost-recovery, online or CD-ROM—and the trainer and consultant for end-user searchers (Dalrymple, 1984; O'Reilly, 1984). Intermediaries are certainly in a unique position since they already have an established service relationship with users, and there seems to be a general acceptance in the literature of the idea that the role of the information specialist will survive.

> As for end-users endangering the jobs of librarians and intermediaries, we see no immediate threat from that quarter. Indeed there is evidence. . . to suggest that online could (certainly initially) provide a boost for the intermediary's prospects. For probably the first time they possess an information tool that can meet the needs of the "busy" practitioners. (Nicholas, Harris, & Erbach, 1987, p. 149)

Evidence suggests that in the future the greatest number of end-users will be outside libraries, untrained and unsupervised, using personal computers in their own homes and offices. Most of them will be well-educated professionals and managerial workers who use computers in their everyday lives. So long as access is convenient and efficient, they will use online bibliographic search systems as extensions of their other research skills. Librarians will need to learn new skills in order to co-exist with them, and should assume a promotional role (Dutton, 1987). Only those information professionals who excel and are flexible will survive (Duckitt, 1984).

In order to enable more users to perform their own searches it is clear that system enhancements are needed, and the answer to how best they can be implemented appears to hinge on the use of artificial intelligence techniques to provide an "expert" system front-end for searching (Smith, 1980; Vickery, 1984). Expert systems use a computerized knowledge base developed from the experience of an expert in the subject field, and a set of rules which control the application of the knowledge, so as to assist the novice in decision-making tasks. Although a number of experimental systems of this sort have been developed (Crystal & Jacobson, 1982; Marcus & Reinjes, 1981a, 1981b; Meadow, Hewett, & Aversa, 1982a, 1982b), they are still in the experimental stages and are generally restricted to a single database or to a limited subject field (Pollitt, 1984). A number

of expert system software "shells" are becoming available which enable any subject expert to build his own knowledge base and decide on the rules for its application. The major problem with this approach appears to lie in the fact that online searching is not a domain of knowledge in the same sense that geology and medicine (for example) are. Nevertheless, expert systems appear to be the direction in which developments for the simplification of online searching are moving at present. It remains to be seen how far information-seeking behavior (which is believed to be, at least in part, almost intuitive) can be emulated by a rule-based computer system.

Over the past five years or so the online industry's search for the elusive end-user market has led to a concentration on ways to simplify the system mechanics. Long-term searchers have been almost ignored, and enormous effort has gone into the technical support required by untrained users. Whether these moves will produce the looked-for upturn in the market remains to be seen. The literature suggests that at present only small numbers of users are prepared to integrate online into their information-seeking behavior, and that the technological gap has still not been bridged. It appears that this is not solely a question of ease of use, but of long-established and ingrained behavior patterns. The spread of end-user use of online systems has certainly been much slower than expected, and there is still a long way to go. Most of the early expectations for unlimited markets, standardized systems, reduced costs, simplicity, etc., have still not been fulfilled (Arnold, 1988), and further system enhancements are necessary before the mass end-user market becomes a reality.

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